Field Evaluation
CairPol Cairsens NO_2 Sensor

South Coast AQMD

AQ-SPEC
Air Quality Sensor Performance Evaluation Center

Background

- From 11/22/2018 to 01/18/2019, three **CairPol Cairsens NO_2** sensors were deployed at a SCAQMD stationary ambient monitoring site in Rubidoux and were run side-by-side with a reference instrument measuring the same pollutant

- **CairPol Cairsens NO_2 (*3 units tested*):**
  - Each unit reports: NO_2 (ppb), Temperature (°C), Relative Humidity (%)
  - Unit cost: $1198
  - Time resolution: 1 - min
  - Units IDs: 4541, 4542, 4543

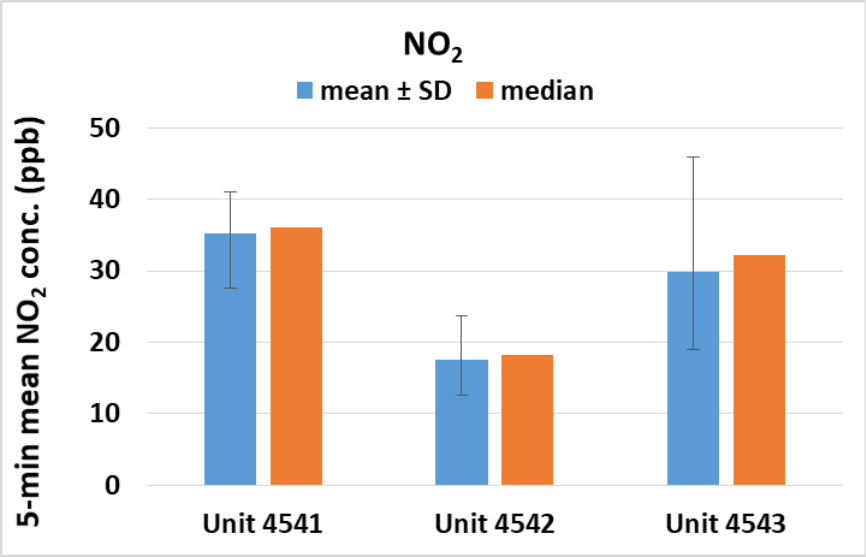
- **SCAQMD Reference instruments:**
  - NO_x instrument: FRM
    - cost: ~$10,000
    - Time resolution: 1 - min
  - Met station (Temperature, Relative Humidity, Pressure, Wind Speed, Wind Direction)
    - cost: ~$5,000
    - Time resolution: 1 - min

Data validation & recovery

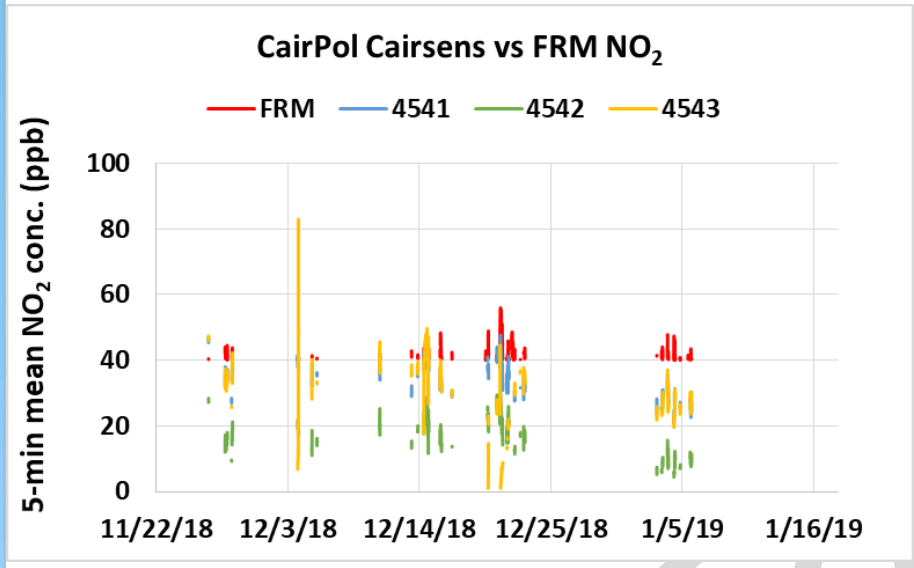
- Basic QA/QC procedures were used to validate the collected data (i.e. obvious outliers, negative values and invalid data-points were eliminated from the data-set)
- Data recovery from all units was 4.3% for NO_2 measurements. Data recovery is calculated based on the 5-min averages FRM NO_2 measurements due to the fact that the sensors have a limit of quantification of 40 ppb as specified by the manufacturer, all values below 40 ppb as measured by the FRM NO_2 instrument were excluded from the data set for further analysis

CairPol Cairsens NO_2 ; intra-model variability

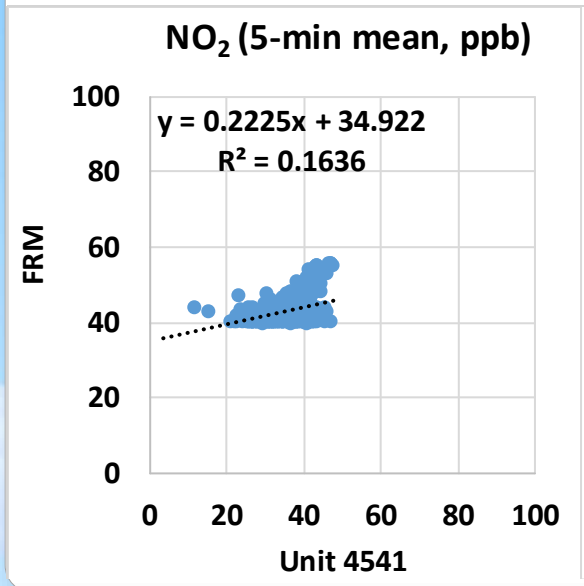
- High measurement variability (64%) was observed between the three CairPol Cairsens NO_2 units

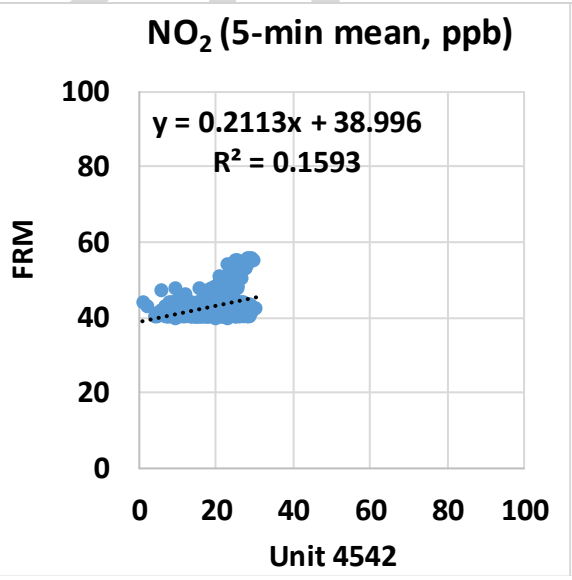


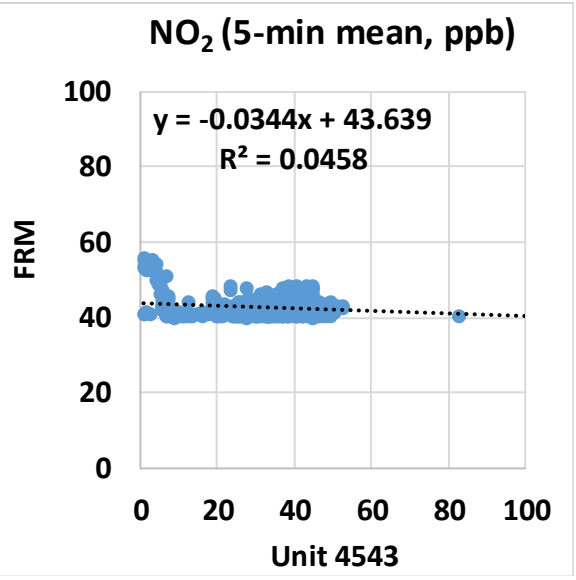
CairPol Cairsens vs FRM (NO_2; 5-min mean)



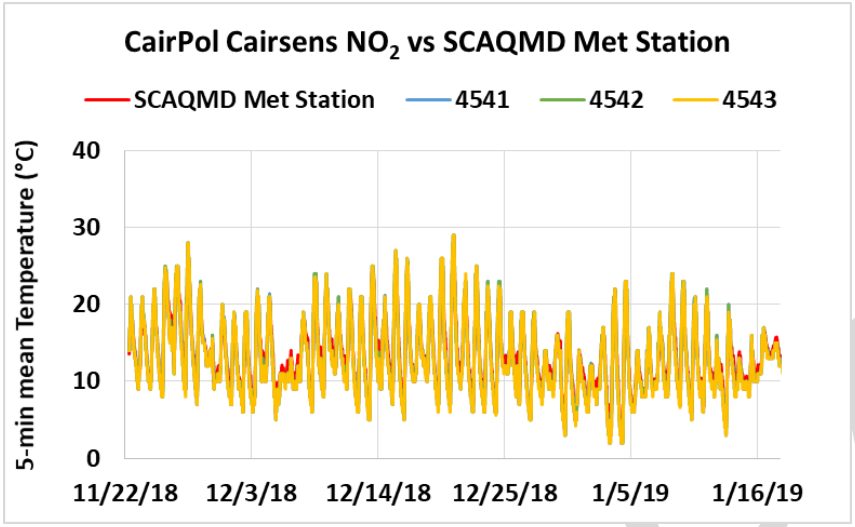
- CairPol Cairsens sensors do not correlate with the corresponding FRM NO_2 data ($R^2 \sim 0.12$)
- Overall, the CairPol Cairsens sensors underestimates NO_2 concentration as measured by the FRM instrument
- The CairPol Cairsens sensors do not track the NO_2 diurnal variations as recorded by the FRM instrument
- Due to the lack of data points, further analyses on 1 and 24 - hr averages are not reported



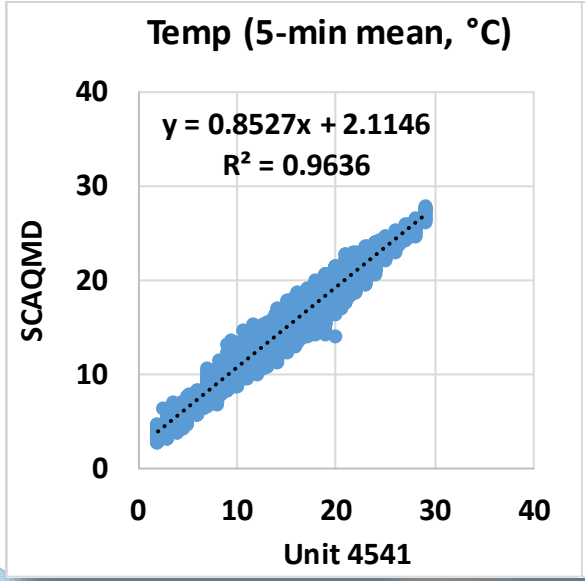


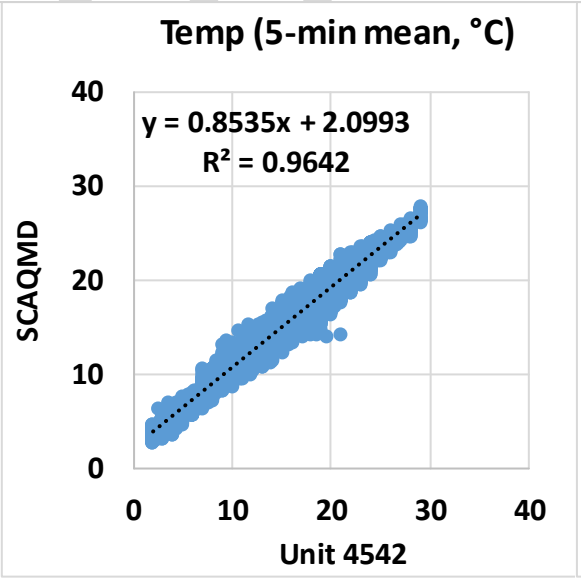


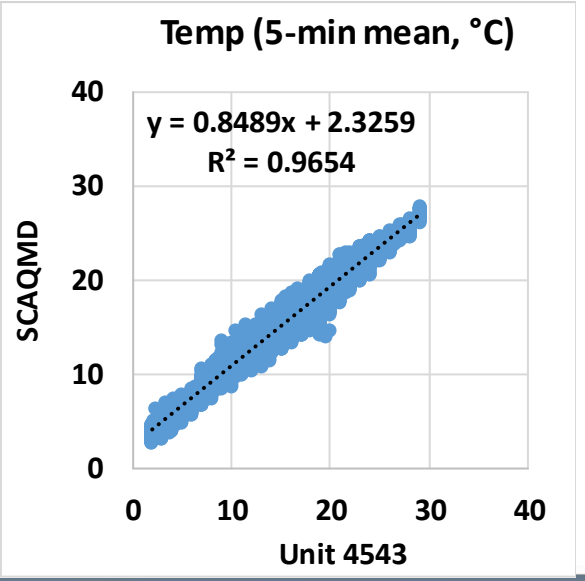
CairPol Cairsens CO vs SCAQMD Met Station (Temp; 5-min mean)



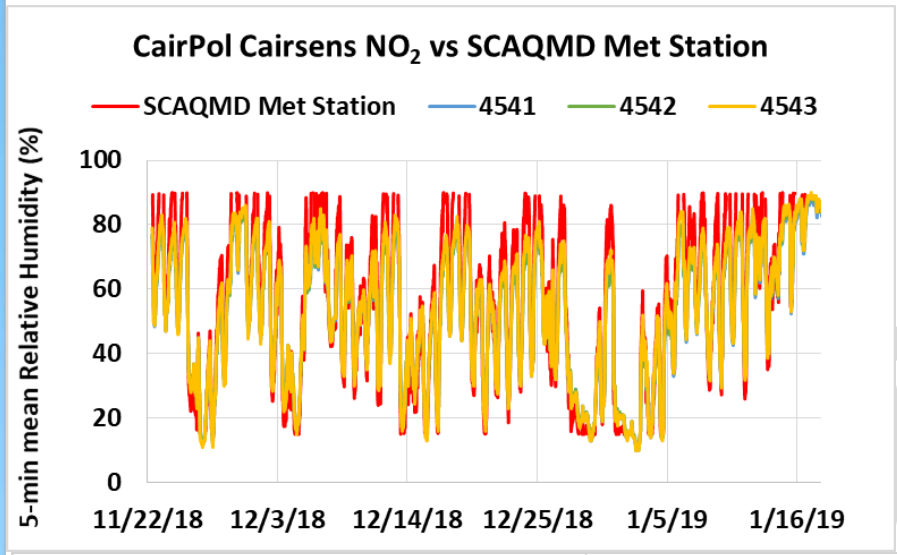
- CairPol Cairsens NO_2 temperature measurements correlate very well with the corresponding SCAQMD Met Station data (R^2 ~ 0.96)
- Overall, the CairPol Cairsens NO_2 sensors overestimate temperature measurements as recorded by SCAQMD Met Station
- The CairPol Cairsens NO_2 sensors seem to track well the temperature diurnal variations as recorded by SCAQMD Met Station





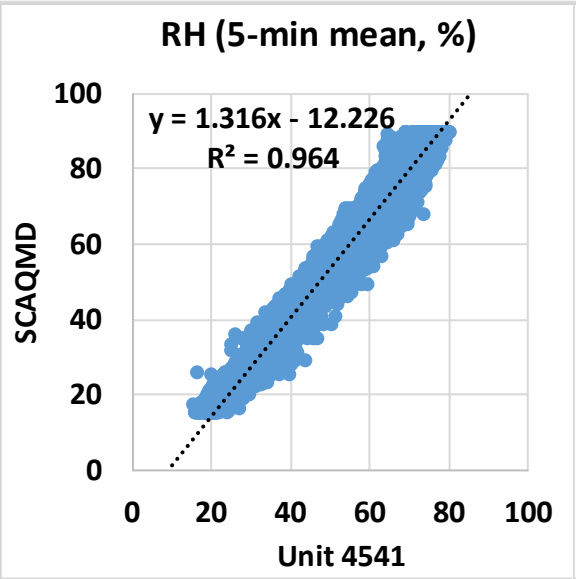


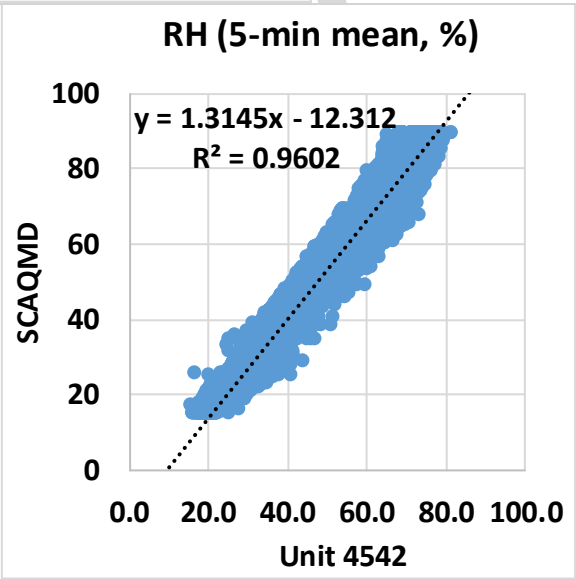
CairPol Cairsens NO_2 vs SCAQMD Met Station (RH; 5-min mean)

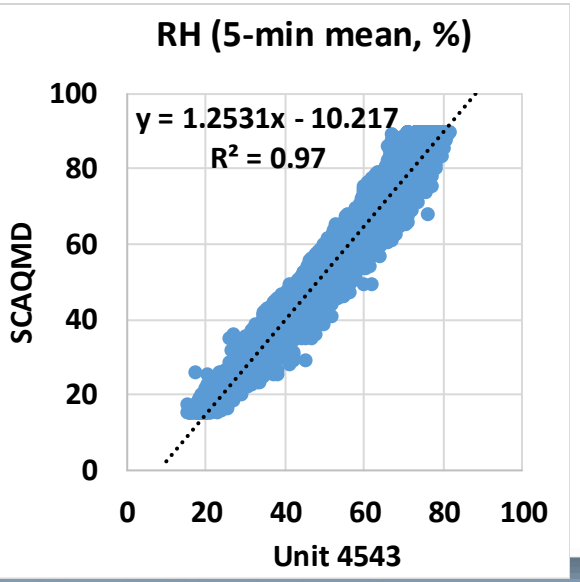


- CairPol Cairsens NO_2 RH measurements correlate very well with the corresponding SCAQMD Met Station data (R^2 ~ 0.96)
- Overall, the CairPol Cairsens NO_2 sensors underestimate RH measurements as recorded by SCAQMD Met Station
- The CairPol Cairsens NO_2 sensors seem to track well the RH diurnal variations as recorded by SCAQMD Met Station

Note: the CairPol Ciarsense RH sensor has an operational range between 10 and 90%, all values below 10% and over 90% are excluded







Discussion

- The three **CairPol Cairsens NO_2** sensors' data recovery from each unit was 4.3%, Data recovery is calculated based on the 5-min averages FRM NO_2 measurements due to the fact that the sensors have a limit of quantification of 40 ppb as specified by the manufacturer, all values below 40 ppb as measured by the FRM NO_2 instrument were excluded from the data set for further analysis
- The three sensors showed high intra-model variability (64%) for NO_2 measurements
- The CairPol Cairsens NO_2 sensors do not correlate with the FRM instrument (R^2 ~ 0.12) and do not track the NO_2 diurnal variations as measured by the FRM instrument
- No sensor calibration was performed by SCAQMD Staff prior to the beginning of this test
- Laboratory chamber testing is necessary to fully evaluate the performance of these sensors under known aerosol concentrations and controlled temperature and relative humidity conditions
- All results are still preliminary